

THE GAMMA-RAY SPECTRA OF $\text{Na}^{24} \rightarrow \text{Mg}^{24}$ AND
 $\text{Sb}^{124} \rightarrow \text{Te}^{124}$ AS MEASURED BY PAIR PRODUCTION
IN THE GAS OF A WILSON CLOUD CHAMBER

BY

WILLIAM ELWOOD OGLE

A.B., University of Nevada, 1940

M.A., University of Illinois, 1942

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
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The gamma-rays due to the radioactive decay of Na^{24} and Sb^{124} were used to produce positron-electron pairs in the gas (air) of a cloud chamber. A collimating slit (surrounded by lead) one inch wide, one-half inch high, and about forty inches long provided adequate collimation so that it was easy to apply rigid rules to the selection of pairs. Only those showing little evidence of scattering and occurring within a 20° cone of the forward direction were accepted as valid data.

Twelve thousand pictures taken using a one m.c. Sb^{124} source of gamma-rays yielded five pairs, leading to a value of the gamma-ray energy of 1.70 ± 0.02 Mev. The spread of energies calculated from the five pairs show that the probable error in calculating the gamma-ray energy from one pair at this energy is about 0.024 Mev.

Eleven thousand pictures taken using a 250 ± 200 m.c. Na^{24} source of gamma-rays yielded 56 pairs, two of which were "Triplets", i.e., pairs produced in the field of an electron. The twelve best pairs, picked because they had very long positron and electron tracks, and showed absolutely no evidence of scattering, fall into four energy groups between 2.5 and 3.0 Mev. The rest of the pairs were arranged according to which energy group they were nearest. The average energy of each group was calculated weighing the pairs inversely as their probable error as calculated from the spread in individual measurements made of the same pair. These data give evidence of four gamma-ray lines of energies 2.56, 2.68, 2.76, and 2.89 Mev, and of relative intensities 25.8 : 15.4 : 16.0 : 9.1. One pair was observed that indicated a gamma-ray energy of 3.24 ± 0.1 Mev, of relative intensity 0.94.

Other investigators^{1,2} report a gamma-ray of energy about 1.38 Mev in addition to a higher energy gamma-ray at about 2.8 Mev. The 1.38 Mev line would not be observed in the present investigation because of the low pair production probability at that energy. Coincidence measurements by other investigators^{3,4} indicate that at least two gamma-rays are emitted for each beta-ray decay. The beta-ray measurements⁵ of other investigators show that there are three beta-rays emitted from Na^{24} of energies 1.84, 1.63, and 1.1 Mev.

It is proposed then that Na^{24} decay with the emission of the three betas mentioned above to three excited levels of Mg^{24} at 3.94, 4.14 and 4.67 Mev above ground. These levels then decay with the emission of 2.56, 2.68, 2.76, 2.89, and 3.24 Mev gamma-rays to two other levels of Mg^{24} at 1.38 and 1.26 Mev above ground. Those levels in turn decay by emission of 1.38 and 1.26 Mev gammas to the ground level of Mg^{24} .

During the investigations on Na^{24} two triplets, or pairs produced in the field of an electron, were observed. They indicated gamma-ray energies of 2.68 and 2.66 Mev, agreeing well with the energy of the 2.68 Mev line of the previous paragraph.

The writer is grateful to Professor P. Gerald Kruger for the great amount of direction and cooperation in this research.

¹ Mandeville—Phys. Rev. **63**, 387, (1943)

² Elliott, Deutsch, Roberts—Phys. Rev. **63**, 386, (1943)

³ Langer, Mitchell, McDaniel—Phys. Rev. **56**, 962, (1939)

⁴ Watase—Physico Math. Soc. Japan **23**, 618, (1941)

⁵ Kikuchi, et. al.—Physico Math. Soc. Japan **21**, 381, (1939)

VITA

William Elwood Ogle was born in Los Angeles, California, August 30, 1917. He graduated from the Las Vegas, Nevada, Grammar School in 1931, and from the high school of the same city in 1935. He entered the University of Nevada in 1936 and received his A.B. in 1940. Since that time, he has been doing graduate work in Physics at the University of Illinois. He served as an assistant in Physics his first year at Illinois, followed by two years as a fellow. The last year he served as an instructor in Physics. He received his M.A. in 1942.

